

THE RELATIONSHIP OF THE WEATHER IN NEW ENGLAND
TO CERTAIN CARDIAC CONDITIONS. A STUDY OF
PATIENTS SEEN IN PRACTICE DURING
THE PAST TEN YEARS.

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Ancient authorities, Hippocrates, Celsus, and Galen, had a good deal to say about the relationship of climate and weather to health, but nothing about its relationship to heart disease, because heart disease was not then recognized. The same is true of medieval medical writings, as in the Salernitan Code. Statements begin to appear after the discovery of heart disease in the seventeenth century as to the possible influence of climate and weather, but they are in the main simple expressions of opinion. Lancisi³ in studying the causes for an increased number of cases of sudden death in Rome over 200 years ago (1705-6) referred to the fact that sudden death was commoner when there was a cold wind. Similar references to the relationship of cold weather to mortality from cardiovascular disease have been made since, as in recent years, for example, by Stock,⁶ by Bundesen and Falk,¹ and by Cohn,² and in 1933 Dr. George Shattuck⁵ noted that prolonged high temperature and high humidity tended to increase the number of deaths (chiefly circulatory) in Boston and that high wind velocity tended to decrease them. A number of reports have been made of the geographical distribution of circulatory diseases and other conditions like pulmonary diseases, upper respiratory infections, severe infections of other sort like malaria, typhoid fever, and typhus, rheumatism, thrombosis, and nervous ailments have been more or less studied with respect to weather conditions. So far as we have found out, however, no adequate study has as yet been published of attempts to correlate in detail local weather factors and certain very important cardiac conditions, although Petersen,⁴ who has already reported on meteorology and certain diseases (in particular, nervous disorders) will report later on heart disease also, and Wood and Hedley,⁷ have this summer reported an analysis of the seasonal incidence of acute coronary occlusion in Philadelphia.

Dias of Brazil has written on meteorology in relation to disease and one of his lectures concerned the heart; he thought that low barometric pressure, increased humidity, and electrical disturbances have an unfavorable effect on the heart. He stated that edema and dyspnea tend to increase when there is a fall in barometric pressure and that such a fall produces or aggravates excessive vagus tone, which should be combated by atropine or belladonna. However, Dias fails to bring forth any clear evidence for his theories and they must await proof.

An especially suitable occasion for presenting the results of a pioneer scratching of the soil would seem to be a meeting of the American Clinical and Climatological Association. I have searched the tables of contents of the Transactions of the Association for the last fifty years since its origin, but have found no such report. Therefore, I am emboldened to begin to fill this gap today. I warn you, however, that the efforts of Dr. Brasil and myself, have resulted in bringing up only a tiny fragment of what will eventually be needed to fill the gap, but this bit we hope will be of service in arousing interest in the subject and in pointing the way.

DIFFICULTIES.

(a) The greatest and most obvious difficulty in this study is that it is next to impossible to collect a properly controlled series of cases. There are so many factors besides weather conditions acting on each case that doubtless many thousands of patients would have to be studied carefully in order to select even a few hundred cases in whom other factors of strain and disease might be considered to be even grossly comparable.

(b) In the second place, after such a selection had been made it would still be of considerable importance to take into consideration individual reactions to weather conditions. Some persons prefer hot weather to cold, dry weather to damp, and windy weather to still, noting then better conditions of health, while others prefer the reverse.

(c) Finally, the weather conditions may have little or no chance to affect the patient if he is living in a more or less artificial atmosphere, quite protected from weather strains, even sometimes in respect to humidity nowadays. For example, a man suffering from angina pectoris may wisely stay indoors quietly at home on a blustery

winter day or on a very hot humid midsummer day, but engage in rather active exercise when stimulated by weather that is clear and cool, thereby exceeding his coronary reserve with fatal result, even on a fine day in June or September.

A few examples from my own practice will illustrate the fact that weather strains may or may not be factors in the onset or occurrence of certain cardiac conditions.

CASE 1. A parson, 61 years old, consulted us on May 6th, 1933, because of angina pectoris on effort which first came on seven years before. Latterly it had increased somewhat in frequency and he had noted an especially severe attack on walking against a cold wind. The trouble was always more likely to come on effort directly after meals. He had improved a good deal by ceasing to hurry. Examination, including electrocardiography, showed nothing amiss except for slight hypertension and slight cardiac enlargement. He was warned to avoid exercise after meals, hurry, and severe weather, but he failed to heed this warning and on December 26, 1933, the day of a severe snow storm, he died suddenly after climbing a hill in the blizzard. His death that day was undoubtedly preventable.

CASE 2. A business man, 52 years old, came for examination in the spring of 1931 because of angina pectoris on effort which had begun to bother him the previous summer while playing golf, checking him usually once or twice on the first hole, but not after that; that is, he could play the next seventeen holes without trouble. He was warned against golf until he was better, but, an ardent golfer, he resumed the game in the summer and on a good summer day, died suddenly on the fairway of the first hole of the golf links. In this case, also a preventable death, the weather had little influence except perhaps to encourage him to be too strenuous.

CASE 3. A college professor, 57 years old, on January 22, 1931, began to suffer from angina pectoris on effort and on January 25, three days later, suffered a severe typical attack of coronary thrombosis from which he had an uneventful convalescence with no more coronary pain since then. This illness came in the winter.

CASE 4. A business man, 69 years old, previously always in good health except for typhoid fever twenty-five years before, was seized while seated in his office on the afternoon of a pleasant June

day by severe substernal oppression which continued for nearly twenty-four hours and which resulted in death on June 10, four days later.

CASE 5. A manufacturer, 65 years old, came for examination this year because of angina pectoris on effort, which began during the winter of 1933 to 1934, recurred frequently on the colder days that winter, almost ceased entirely during the summer and then recurred with the onset of cold weather in the fall. During the past winter he began to be disturbed also at night by typical attacks relieved by nitroglycerine at a time when he was much worried by illnesses in the family. In the summer he improved once more, but not to the favorable level of the preceding summer.

CASE 6. A contractor, 66 years old, with hypertensive heart disease and a large heart, began to suffer from attacks of nocturnal orthopnea, coming about once a week during the winter. That next summer he improved greatly, but in the following winter the trouble recurred. Again he was better when the warmer weather came. Finally, in the particularly cold winter that followed, the third winter of his illness, he grew much worse again and finally died of congestive failure the next spring. Digitalis therapy was carried on most of these two and one-half years.

CASE 7. A foreman, 63 years old, began to have attacks of cardiac asthma in the summer of 1925, at first infrequently. He showed on examination hypertension and marked cardiac enlargement. In 1928 the attacks recurred much more often, generally every night. In July he showed extensive dropsy and in September died of congestive failure. It appears that weather conditions played little or no rôle in this case.

CASE 8. A nurse, 32 years old, came to us in November, 1931, because of paroxysms of regular tachycardia which had first appeared ten to twelve years before while she was playing basketball at school. She stated that her paroxysms were most likely to occur when she was tired, at the time of her catamenia, or especially when very strenuous physically, as on a camping trip. She was less bothered in the winter when she was not so active. Examination showed no evidence of heart disease.

METHOD OF PRESENT STUDY.

(a) Selection of groups of cases (my own cases in and near Boston in the past ten years) of (1) angina pectoris (243), (2) coronary thrombosis (179), (3) paroxysmal dyspnea (109), (4) congestive failure deaths (74), (5) sudden deaths (89), (6) cardiac deaths not specified (128), and (7) paroxysmal tachycardia (180) in whom there was definite information as to the date of onset or occurrence of the conditions.

(b) Tabulation of these groups of cases by months, according to onset and occurrence, and division into two series (1) those with onset and occurrence during the colder months of the year (October to March inclusive), and (2) those during the warmer months (April to September inclusive).

(c) Collection of detailed daily weather data from the Boston Weather Bureau for the past fifteen years: (1) temperature, maximum, minimum, and range, (2) barometric pressure, maximum, minimum, and range, (3) humidity, maximum and minimum, (4) rain fall, (5) snow fall, (6) wind direction, and (7) wind velocity.

(d) Correlation of the onset and occurrence of the various cardiac conditions mentioned above with the individual and combined weather conditions.

Possible weather strains more or less arbitrarily selected were temperatures above 80 degrees Fahrenheit and below 32 degrees, temperature ranges of more than 25 degrees and less than 10, barometric pressure of more than 30.5 inches and less than 29.5, relative humidity of over 85 per cent and under 55, rainfall, snowfall, wind direction from the northeast, east, or north, and wind velocity of over 25 miles an hour or under 7.

Dr. Brasil (of Brazil) has spent a great many hours in collecting the data for me and in aiding me in the correlation.

RESULTS OF STUDY.

TABLE 1.

FREQUENCY OF CERTAIN CARDIAC CONDITIONS.

ATTACKS, CASES, BY MONTHS.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Angina Pectoris												
Cases	27	27	36	18	20	26	21	24	24	35	25	32
Attacks	433	395	326	394	260	169	182	260	330	459	472	470
Cardiac Asthma												
Cases	10	14	7	12	10	7	8	11	7	12	13	11
Attacks	148	97	89	92	66	12	48	49	93	99	140	150
Paroxysmal Tachycardia												
Cases	34	27	20	22	20	22	21	22	25	26	20	25
Attacks	112	105	102	76	58	189	132	120	111	81	62	102
Sudden Death												
Congestive Failure												
(Deaths)	6	8	8	7	4	8	5	5	2	8	7	6
Coronary Thrombosis....	20	9	12	20	20	13	9	19	8	19	16	14
Cardiac Death												
(Intermediate)	11	9	14	12	17	10	8	8	10	6	8	15

TABLE 2.

RELATIVE FREQUENCY OF CERTAIN CARDIAC CONDITIONS.

CASES AND ATTACKS.

IN COLD MONTHS AND IN WARM MONTHS.

	Total of Patients	Total of Onset or Recurrence	Total of Frequency	From Oct.-Mar.	From Apr.-Sept.
Angina					
Pectoris	243	315	4,150	O+R— 182 (58%) Freq.—2555 (62%)	O+R— 133 (42%) Freq.—1595 (38%)
Cardiac					
Asthma	109	122	1,083	O+R— 67 (55%) Freq.— 723 (67%)	O+R— 55 (45%) Freq.— 360 (33%)
Paroxysmal					
Tachycardia	180	284	1,190	O+R— 152 (53%) Freq.— 564 (48%)	O+R— 138 (47%) Freq.— 626 (52%)
Sudden Death	89	89	89	49 (55%)	40 (45%)
Congestive Failure					
(Death)	74	74	74	43 (58%)	31 (42%)
Coronary					
Thrombosis	179	179	179	90 (50%)	89 (50%)
Cardiac Death					
(Intermediate) ..	128	128	128	63 (49%)	65 (51%)

O—Onset. R—Recurrence. Freq.—Frequency.

TABLE 3.
RELATIONSHIP OF CERTAIN CARDIAC CONDITIONS TO POSSIBLE FACTORS OF STRAIN DUE TO THE WEATHER.

	Temperature				Bar. Press.		Relat. Humid.		Rain		Snow		Wind Veloc. per Mile	
	Max.	Min.	Dif.		Inches				Inches				Max. N.E., 7.0- 19.5	Dirac. N.E. 53.5 91
Days of Year	80+	90+	32-	20-	25+	10-	85+	55-	Rain	Snow			25+	7.0- 19.5
Percentage	46	9	106	61	31	67	86	91	125	42			19.5	53.5 91
	12.5%	2.5%	29%	17%	9%	18%	24%	25%	34%	12%			5.5%	15% 25%
Coronary Thrombosis (82 cases)	5	0	19	9	5	17	22	21	39	10			20	24 17
Angina Pectoris (38 cases)	6%	0%	23%	11%	6%	21%	27%	26%	48%	12%			24%	29% 21%
Sudden Death (54 cases)	8	1	21	11	3	11	10	17	29	11			6	18 20
Cardiac Asthma (33 cases)	14%	2%	36%	19%	5%	17%	17%	29%	50%	17%			10%	31% 34%
	6	2	15	10	6	4	7	10	27	7			8	10 8
	11%	4%	26%	19%	11%	7%	13%	19%	50%	13%			15%	19% 15%
	2	0	7	2	2	8	7	4	16	1			5	12 8
	6%	0%	21%	6%	6%	24%	21%	12%	49%	3%			22%	36% 24%
Congestive Failure (24 cases)	2	1	7	3	4	2	6	5	12	4			4	11 3
	8%	4%	29%	13%	17%	8%	25%	21%	50%	17%			17%	46% 13%
Paroxysmal Tachycardia (55 cases)	6	0	21	3	1	13	14	10	30	15			8	22 13
	11%	0%	38%	5%	2%	24%	25%	18%	54%	27%			15%	40% 24%

TABLE 4.
RELATIONSHIP OF CERTAIN CARDIAC CONDITIONS TO COMBINATIONS OF WEATHER STRAINS AND TO STRAINS OF OTHER SORT.

	Number of Weather Strains					Personal Strains			Total Cases Under Strain			No. of Cases
						No or						
	1	2	3	4	5	Special	Doubtful	No History	Weather	Personal	None	
Days of Year.....	83	89	78	58	29	..	..	..	..	..	..	..
Percentage	23%	24%	21%	16%	8%	..	..	..	92%	..	..	..
Coronary	18	22	17	16	5	12	11	59	78	23	2	82
Thrombosis	22%	27%	21%	20%	6%	..	..	..	95%	..	..	..
Angina	12	13	11	10	9	7	15	36	55	22	3	58
Pectoris	21%	22%	19%	17%	15%	..	..	..	95%	..	..	..
Sudden	19	11	14	5	4	3	2	49	53	5	1	54
Death	35%	20%	26%	9%	7%	..	..	..	98%	..	..	..
Cardiac	7	11	6	2	4	6	3	24	30	9	3	33
Asthma	21%	33%	18%	6%	12%	..	..	..	91%	..	..	..
Congestive	4	8	4	4	3	0	0	24	23	0	1	24
Failure	17%	33%	17%	17%	13%	..	..	..	96%	..	..	..
Paroxysmal	8	13	9	11	10	6	5	44	51	11	3	55
Tachycardia	15%	24%	16%	20%	18%	..	..	..	93%	..	..	..

SUMMARY AND DISCUSSION.

1. Angina pectoris showed in our study a considerably greater incidence of onset or recurrence in the colder months in and near Boston, in the ratio of 182 to 133 when we knew the exact month of onset or recurrence. If we add to these figures the 96 cases who referred to the onset or recurrence of angina pectoris as having been in "cold weather," in the "fall," or in the "winter" and the 29 cases with onset or recurrence in the "spring" or "summer," the ratio becomes 278 to 162 (nearly 2 to 1). With regard to the frequency of individual attacks in the cases, the ratio was 2555 in the colder months to 1595 in the warmer. The chart of the particular days supports these findings, 36 per cent of the cases having their onset or recurrence on days with temperature below 32 degrees Fahrenheit. There was a relatively low percentage for hot days. Low barometric pressure and low relative humidity give findings suggesting an unfavorable effect, as to rain and snow fall also. Extreme velocity of winds and northeasterly direction are more definitely unfavorable. Most of these findings confirm somewhat our impressions, but they are not so conclusive as I had expected them to be — doubtless because of other factors. The weather conditions of the days preceding the days of onset or recurrence of angina pectoris showed nothing of especial note.

2. Coronary thrombosis in our study occurred throughout the year with little or no relationship to weather conditions except that it seemed to be less common in very hot weather and more common when the wind velocity was very high or very low, whatever that may mean. I expect that for these details our cases are far too few in number for even tentative conclusions. Wood and Hedley⁷ in an analysis of 133 attacks of acute coronary occlusion occurring in three hospitals and in private practice in Philadelphia found that 88 were in the colder six months of the year (October to March inclusive) and 46 in the warmer six months (19 in January, 13 in February, 8 in March, 7 in April, 11 in May, 1 in June, 7 in July, 4 in August, 15 in September, 14 in October, 19 in November, and 15 in December), in comparison with 90 and 89 cases respectively in our series in New England. It is probable that both series are as yet too small.

3. Paroxysmal dyspnea and cardiac asthma showed their onset somewhat more commonly in the colder months than in the warmer;

the ratio was 67 to 55. So far as frequency of attacks in the affected cases was concerned the ratio was 2 for the colder months to 1 for the warmer, 723 to 360. In November, December, and January, there were 438 attacks compared to 109 for June, July, and August. High humidity, rainy weather, and extreme wind velocities seemed to have an unfavorable influence, low humidity and warm clear weather a favorable influence.

4. Congestive failure leading to death was somewhat more common in the winter months, 43 to 31, but the numbers of cases are too few to be more than suggestive. Besides the colder weather extreme variations of temperature and low barometric pressure seemed to have an unfavorable influence, and also very still air.

5. Sudden deaths, including angina pectoris deaths. Again the figures are small, but I present them for what they are worth. The greatest number was in August (11) and then in sequence November (10), December (9), and January (8). Extreme variations of temperature, rainy weather, and high wind velocity seemed to exert an unfavorable influence in promoting sudden death.

6. Cardiac deaths of undetermined nature were scattered through the year. There was little information of value to be gained from their analysis.

7. Finally, paroxysmal tachycardia showed little influence from weather conditions; cases of onset or recurrence were slightly more frequent in the colder months, 152 to 138, while the total of attacks in these cases was slightly greater in the warmer months, 626 to 564. More of the patients spoke of the unfavorable influence of summer weather than of winter weather, but at the same time mentioned their more strenuous activity in the summer. High barometric pressure and low humidity seemed to have a favorable influence on many of the cases.

CONCLUSIONS.

We may conclude from this study that the weather in New England does have an influence on certain disorders of cardiac function, especially angina pectoris and paroxysmal dyspnea or cardiac asthma, cold and stormy weather with extreme variations of temperature favoring the occurrence of such conditions. However, the weather is but one factor of many to be taken into consideration and much

more extensive and detailed study is necessary in the future to determine the particular influence of certain individual weather factors, such as humidity, barometric pressure, and wind velocity. Coronary thrombosis, an organic lesion, has not appeared in our study to be particularly influenced by the weather. So far as valvular disease in New England is concerned we already know that the onset of the fundamental major cause, namely the rheumatic infection, is much more common in the winter and spring months with their inclement weather which excites respiratory infections, than in the summer and fall.

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DISCUSSION.

DR. ROBERT L. LEVY (New York): To begin with, I am not surprised that the weather in New England had an effect on heart disease. At the same time, when Dr. White, after his very considerable study admits that he knows very little about the subject, I, after no real study at all, cannot comment to much advantage.

I do think that careful observations of this sort have a very definite therapeutic bearing. If we can determine through further studies along these lines that certain types of weather conditions are unfavorable to particular types of heart disease, we can better advise our patients, that is, those who are able to change their place of residence, where they may live with the greatest comfort and for the greatest length of time.

DR. WILLIAM D. STROUD (Philadelphia): Princeton is quite close to Philadelphia so that I think you have had a sample of the weather there in the last few days. I have learned of no heart attacks as yet.

But, I was very much interested in Dr. White's and his collaborator's study. I think this is a very important point in the treatment of this very common condition, especially the hypertensive and coronary type of cardiovascular disease.

I am wondering about the summer months, whether or not the fact that so many of us take our vacations in the summer and are relieved of the responsibilities of work and business, and so on, might not play a part. Certainly I think it plays a large part in the individuals who go to Europe for spa treatments, and so forth.

We had rather an interesting gentleman in Philadelphia who had a coronary thrombosis in 1912. Although he took very good care of himself he was similar to the case that Dr. White reported, and he insisted on playing golf. He played on the Merion Course. As a great many of his friends died on the course and were dragged in by their feet by the caddies, he insisted that he was going to purchase a stretcher for the Merion Golf course, and it was to be the best stretcher that could be made. He wished to be carried in on a stretcher and not dragged in by the caddies. He purchased that stretcher, and in 1933 in one of the hottest and most humid days of the summer, while playing the course he dropped over and was carried in triumphantly on the stretcher which he had purchased. (Laughter.)

DR. STEWART R. ROBERTS (Atlanta, Georgia): I have been for years interested in this subject. As the speakers who have followed Dr. White have intimated, it is a subject of no small importance.

After watching the effect of southern weather on cardiacs, one, even without these luscious statistics that Dr. White presented, nevertheless is forced to certain very definite and easy conclusions.

In the first place, in the clinics, especially the Ethiopian and the obese individuals, have frequently said to me, and to others working in the clinic, "Oh, if the cold weather would come I would breathe better."

I think we are all, in the South, forced to feel that in the long stretches of hot weather in the summer months that dyspnea, nocturnal dyspnea, paroxysmal dyspnea, cardiac asthma, edema of the lungs are apt to be more frequent. It has been my impression, not reinforced by proof, that in the long stretches of the summer months those angina cases which are afflicted more frequently and more severely in the winter may even, at times, appear to be relieved.

Frequently patients with congestive failure remark during August and in the more sultry dry weather prevailing usually in the first half of September, "Oh, if it would rain, doctor, or just cool off, or give me a few days of cooler weather, I would be better and not need so much medicine," that is, an opiate for relief.

In conclusion, I think these two things stand out in my own experience: First, that congestive heart failure is more frequent and apt to be more severe in the long stretches of warm weather in the South. It is not relieved, but the patient feels more comfortable after a cooling rain, or a few hours, or a few days of uninterrupted cooler weather in the summer, and that secondly, angina may be, in certain cases, apparently lessened, particularly the anginal effort, in summer weather, and more frequently in what we call, in the South, our cold days in the winter, which come only two or three days at a time.

DR. GUY HINSDALE (White Sulphur Springs, W. Va.): Nothing was said

particularly about the changes in elevation, or the effect of altitude on the tendency to recurrence of angina pectoris, or coronary thrombosis.

Now, on arriving at a station one, or two, or three thousand feet above your customary elevation, the effort which is ordinarily not disturbing at the lower level might be quite disturbing at the upper level. In Colorado, it is very well known that the newcomers are stimulated by the air, that is, the stimulus of the new climate, and they find that they are not able to do the things as readily as they did at sea level. If they start out to play a game of golf, they might find it very difficult, whereas if they had waited until they were more adjusted to the climate then the effort would not be attended by any bad results.

I think that even at an elevation of 2000 feet, at which I live, one has to be a little cautious about letting persons take larger quantities of food or smoke very heavy cigars as they start out on the links. I think the imprudence of exercise after partaking of food is much greater when you are situated at an elevation to which you are not accustomed.

DR. C. SIDNEY BURWELL (Nashville): I want to make two small points. I would like to make a suggestion about hot weather, and that is, while I think it is quite clear that extremes of hot weather are bad for everybody, including cardiacs, I should say on the basis of our experience in Nashville that cardiac failure is much more frequent in the wards in winter time. More people die of heart failure in the winter than die of heart failure in the summer.

That leads me very directly to my second point, which I am sure isn't necessary to make. That is, that while meteorological or physical conditions can certainly affect the circulation, yet one has the opinion, I think, that many of the effects of climate on heart failure, on the precipitation of heart failure, are due not to a direct effect of the temperature and pressure relationships on the circulation, but to the fact that colds are more frequent in bad weather and that acute infections are probably the commonest precipitating cause of attacks, or onset, of cardiac failure.

DR. PAUL WHITE (Boston): In the absence of any data that seem to be of value that stimulated us to begin this study, we had in mind what Dr. Levy has emphasized, the possible therapeutic value of it, some ammunition which we might use in suggesting that our patients change their habitat in unfavorable weather periods of the year. However, we may not be able to use that so far as coronary thrombosis, because we haven't any information that supports it. We have it with respect to angina pectoris and paroxysmal dyspnea.

I am sure that vacations in the summer months play a part and have a favorable influence in many cases, but not in all, because as I noted in one or two of the cases the individual is stimulated to more activity in the summer and thereby may have more trouble.

I am confident that it would be of great value, as Dr. Roberts has pointed out, to make a comparative study of the effects of weather changes in different parts of the country.

I was interested to hear the difference of opinion with respect to the South

that Dr. Roberts and Dr. Burwell expressed concerning congestive failure. I think it is necessary to make a further study of that point.

I did not mention climate and altitude in this study. We had not taken that up. I am sure more needs to be done in that respect, too, as to the connection of altitude to angina and vascular conditions.

Dr. Burwell's comment about the indirect effects of weather changes, of course, is a very important point and undoubtedly plays the largest rôle of all in any effect that weather may have on circulation.